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AM or more generally 3D printing

- Additive manufacturing or 3D printing has been quite trending word used now for some years and it has seen some huge developments in late years.
  - New type of metal printers, concrete printers and also continuous fibre (kevlar, carbon, class fibre etc…) printers.
  - Still most of the plastic 3D printers are based on filament extruders, which are good and easy to control, but still lack the capability for bigger scale prints with satisfactory speeds.
    - To counter this the development of pellet extrusion type of printing would need bigger focus.

Advantages of robotized pellet extruder 3D printing

- Parts can be built in big scale -> robot working area as limitation.
- It allows printing in confined or limited spaces where regular printers would just not fit.
- Possibilities for printing in different surfaces like vertical walls or in ceiling.
- Pellet extruder is better option for large scale printing as pellets are cheaper than filaments and also you have much bigger selection for materials.

Challenges

- Software is not yet fully there to fully utilize robots for 3D printing purposes…
  - Just one software that is able to do it with relatively ”little” effort -> RoboDK.
  - Slicer software that handles the slicing of 3D printer files do not support more than 3 axis -> all printing motions with robot are actually 3 axis motions because of this.
  - Example: RoboDK uses slicer software to slice the 3d models and then roboDK processes these to format that robot can understand.
- Custom software really is needed to achieve full 6 axis printing and the advantages it would give comapared to regular 3 axis printing.

RoboDK

- Very light program and has quite powerful features.
- Software allows you to make offline programming to robots and has a support for quite many robots and supports you to even model your own robot.
- It has built in post processors for all the robots it supports and also includes post processors for 3D printing, painting, machining -> though 3D printing post processor had to be modified manually for it to function.
- It has ability to simulate program and work as digital twin for some degree.

Our setup

- We use Universal robots UR10 for our tests as this is fully supported in RoboDK and we have it available for our testing purposes
- Pellet extruder is from Direct3D and it is still at prototype stage -> lots of improvements could be done to increase print quality.
- To control the pellet extruder stepper motor we built simple test setup with arduino and A4988 stepper driver board and some custom code.
  - Robot sends analog signal to arduino which drives extruder.
- Heaters controlled with regular PID controls -> no feedback to robot.
- Our printing material is our own production of polypropylene with wood fibres.

Observations results and further development

- 3D printing with robot and using pellet extruder had some good results and we noticed best way to actually print with extruder is varying robot speed and keeping extrusion stable.
- Printing time was fast and quality still relatively good.
- Printing was most succesful when printing with stable extrusion speed and varying the robot speed to achieve good layers.
- As was mentioned earlier software development for full 6 axis 3D printing and for some other advantages for robotized 3D printing can be achieved -> now 6 axis printing requires huge amount of manual programming.


Thank you for your interest!
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